

investigated. Research on reproduction and recruitment would be conducted to better understand the species' biology.

Following experimental research, habitat management techniques to promote conditions suitable for the growth and establishment would be implemented. This may include, but is not limited to, reduction in grazing; use of prescribed burns, restoration of winter flood/summer drought regime; and removal of other stresses.

## INTEGRATION WITH OTHER RESTORATION PROGRAMS

Efforts to restore seasonal wetlands would involve cooperation with other restoration programs, including:

- Upper Sacramento River Fisheries and Riparian Habitat Council,
- California Department of Fish and Game wildlife areas,
- Jepson Prairie Preserve,
- Ducks Unlimited Valley Care Program,
- California Waterfowl Association,
- the Nature Conservancy,
- U. S. Fish and Wildlife Service,
- Yolo County Habitat Conservation Plan,
- and Central Valley Habitat Joint Venture.

Two occurrences of Colusa grass are currently protected: the Solano County occurrence at the Nature Conservancy's (TNC) Jepson Prairie Preserve and the Flying M Ranch in Merced County, where conservation easements protect some of the large vernal pools. Heartscale occurs with two other species dwarf downingia and legenere at the Nature Conservancy's Jepson Prairie Preserve.

## LINKAGE WITH OTHER ECOSYSTEM ELEMENTS

The vernal pool guild of plant species is linked with the restoration of vernal pool habitat. Stressors that could effect these species include: non-native weedy grasses and grazing.

## OBJECTIVE, TARGETS, ACTIONS, AND MEASURES



The Strategic Objective is to contribute to the recovery of at-risk native species in the Bay-Delta estuary and its watershed.

### SPECIES TARGET

**ALKALI MILK-VETCH:** Protect extant populations and reintroduce species near extirpated populations.

**CRAMPTON'S TUCTORIA:** Review and update recovery plan targets, protect all extant occurrences, and manage habitat to benefit Crampton's tuctoria.



The Strategic Objective is to maintain abundance and distribution.

**SPECIES TARGET:** An increase in or no discernable adverse effect on the size or distribution of species populations for Colusa grass, Boggs Lake hedge-hyssop, Contra Costa goldfields, legenere and heartscale.

**LONG-TERM OBJECTIVE:** Have self-sustaining populations of Colusa grass, Boggs Lake hedge-hyssop, Contra Costa goldfields, legenere, alkali milk-vetch, Crampton's tuctoria, and heartscale and similar declining endemic species located throughout their original native range in vernal pools associated with the Bay-Delta estuary.

**SHORT-TERM OBJECTIVE:** Protect existing populations of the species and restore habitat to provide sites for expansion of all rare native species that require vernal pool or other wetland habitat.

**RATIONALE:** The seven species listed here are examples of plants that are largely endemic to vernal pool and other wetland areas throughout the Bay-Delta estuary and watershed. Restoration of these species to the point where they were no longer in danger of extinction would indicate that major perennial grassland-vernal pool-wetland restoration projects in the region had succeeded.

**STAGE 1 EXPECTATIONS:** The status of the eight species listed here will have improved. Surveys of present ranges of the species (and other rare vernal pool plants), studies of their ecological requirements, and identification of key restoration sites will have been completed. On-going marsh restoration projects in the Bay-Delta will have been evaluated according to their success at restoring rare native plant species and lessons learned applied to new projects.

## RESTORATION ACTIONS

The targets for vernal pool special-status species include identifying high-quality habitats and populations and restoration and reestablishment of populations in order to maintain diversity and ensure the sustainability of each species.

- Protect existing habitat and restore and reestablish vernal pool habitats within and adjacent to existing ecological reserves.
- Implement restoration of habitat and reintroduction of species on historic sites in conjunction with long-term monitoring and maintenance of existing and newly established populations.
- Conduct reproduction and recruitment research to better understand the species biology.
- Conduct site-based evaluation of populations and develop criteria for ranking sites and protection of high-quality sites.

## MSCS CONSERVATION MEASURES

The following conservation measures were included in the Multi-Species Conservation Strategy (2000) to provide additional detail to ERP actions that would help achieve species habitat or population targets.

### BOGGS LAKE HEDGE-HYSSOP AND GREENE'S LEGENRE

- To the extent consistent with ERP objectives, enhance or restore suitable habitats to benefit these species in occupied habitat areas.

### HEARTSCALE

- Develop a seedbank from all populations affected by implementation of CALFED actions and use

the collected seed for inoculating unoccupied suitable habitat.

- To the extent consistent with ERP objectives, enhance or restore suitable habitats to benefit these species in occupied habitat areas.

### COLUSA GRASS AND CONTRA COSTA GOLDFIELDS

- Before implementing actions that could result in the loss or degradation of occupied habitat, conduct surveys in suitable habitat that could be affected by CALFED actions to determine whether species are present.

### CRAMPTON'S TUCTORIA

- Establish three new self-sustaining populations in conjunction with establishment of Delta green ground beetle populations.
- Maintain existing populations.

### ALKALI MILKVETCH

- Protect extant populations and reintroduce species near extirpated populations.
- Monitor status and distribution of populations for the duration of the Program and design and implement conservation measures if a decline in population size or vigor is observed.

## REFERENCES

- Department of Fish and Game. 1992. Annual report on the status of California State listed threatened and endangered animals and plants. Sacramento, CA.
- Holland, R. F., and S. Jain. 1977. Vernal pools. Pages 515-533 in M. E. Barbour and J. Major (eds.), *Terrestrial vegetation of California*. John Wiley & Sons. New York, NY.
- Holland, R. F. 1978. The geographic and edaphic distribution of vernal pools in the Great Central Valley, California. (Special Publication No. 4.) California Native Plant Society. Berkeley, CA.
- Jain, S. 1976. Some biogeographic aspects of plant communities in vernal pools. Pages 15-21 in S. Jain (ed.), *Vernal pools: their ecology and*

conservation. (Institute of Ecology Publication No. 9.) University of California. Davis, CA.

Jones & Stokes Associates, Inc. 1990. Sacramento County vernal pools: their distribution, classification, ecology, and management. (JSA 89-303.) Sacramento, CA. Prepared for Sacramento County Planning and Community Development Department, Sacramento, CA.

Multi-Species Conservation Strategy. 2000. CALFED Bay-Delta Program, Programmatic EIS/EIR Technical Appendix. July 2000.

Natural Diversity Data Base (NDDB). 1996. Record search for occurrence of *Neostapfia colusana*, *Gratiola heterosepala*, *Lasthenia conjugens*, *Legenere limosa*, *Astragalus tener* var. *tener*, *Downingia pusilla*, *Tuctoria mucronata*, and *Atriplex cordulata*. California Department of Fish and Game, Sacramento, CA.

Ornduff, R. 1979. Unpublished status report on *Lasthenia conjugens*. California Native Plant Society, Sacramento, CA.

Skinner, M. W., and B. M. Pavlik. 1994. Inventory of rare and endangered vascular plants in California. 5th edition. (Special Publication No. 1.) California Native Plant Society. Sacramento, CA.

Strategic Plan for Ecosystem Restoration. 2000. CALFED Bay-Delta Program, Programmatic EIS/EIR Technical Appendix. July 2000.

Thorne, R. F. 1984. Are California's vernal pools unique? Pages 1-8 in S. Jain and P. Moyle (eds.) Vernal pools and intermittent streams. (Institute of Ecology Publication No. 28.) University of California. Davis, CA.

# ◆ PERENNIAL GRASSLAND SPECIAL-STATUS PLANT SPECIES

## INTRODUCTION

Perennial grassland was historically common throughout the Central Valley. Most perennial grassland has been lost or converted into annual grassland dominated by non-native species. Perennial grassland provides important breeding and foraging habitat for many wildlife species and supports several special-status plant species, including the recurved larkspur (*Delphinium recurvatum*).

## SPECIES DESCRIPTION

**RECURVED LARKSPUR** (*Delphinium recurvatum*) is a perennial herb with light blue and white flowers in the Buttercup family (Ranunculaceae). It is considered a species of concern by the USFWS and is considered rare, threatened, or endangered by the California Native Plant Society (List 1B). Recurved larkspur inhabits poorly drained, fine, alkaline soils in grassland in the Central Valley and surrounding foothills of the Coast Ranges from Colusa County to Kern County (NDDB 1996). Much of the larkspur's habitat has been converted to agriculture, and is also threatened by grazing.



### VISION

The vision for recurved larkspur is to maintain populations of this California Native Plant Society List 1B plant species.

The vision for the recurved larkspur and other perennial grassland species is to protect existing populations, promote the recovery of the species' habitat, establish new populations, and manage occupied sites properly to ensure the long-term viability of the species. A site-based evaluation of existing populations would be conducted, criteria on habitat and populations conditions developed, and all sites ranked based on the criteria in terms of low to high quality habitat. Based on the site rankings, the highest quality populations would be protected.

To ensure the long-term viability of the species, lower quality sites would be evaluated for potential habitat

restoration or enhancement opportunities. Existing populations would be expanded through habitat restoration, enhancement, and appropriate management. The species' grassland habitat would be protected from overgrazing and trampling by livestock. Appropriate management techniques, such as lowered grazing regime, prescribed burns, and exotics control would be evaluated and appropriate techniques implemented to promote the health and vigor of existing and restored populations.

## INTEGRATION WITH OTHER RESTORATION PROGRAMS

Restoring perennial grassland is an objective of the Cache Creek Corridor Restoration Plan and Yolo County Habitat Conservation Plan. Additional efforts to restore habitat for the recurved larkspur will involve cooperation with programs managed by several agencies and organizations. These include:

- Cosumnes River Preserve,
- Grizzly Slough Wildlife Area,
- Jepson Prairie Preserve,
- Putah Creek South Fork Preserve,
- Stone Lakes National Wildlife Refuge, and
- Woodbridge Ecological Reserve.

## LINKAGE WITH OTHER ECOSYSTEM ELEMENTS

Recurved larkspur is linked with a habitat ecosystem element, perennial grassland. Land use, human disturbance, and non-native species are stressors that could adversely affect the perennial grassland special-status plants.

## OBJECTIVE, TARGETS, ACTIONS, AND MEASURES



The Strategic Objective is to maintain abundance and distribution.

**SPECIES TARGET:** An increase in or no discernable adverse effect on the size or distribution of species populations.

**LONG-TERM OBJECTIVE:** Preserve and restore perennial grassland habitat that provides for special status plant species.

**SHORT-TERM OBJECTIVE:** Develop or utilize existing GIS overlays which depict specific sites supporting special status perennial grassland plant species and compare these sites to other proposed restoration measures for the restoration of wetland and riparian habitat.

**RATIONALE:** Protection and restoration of special status plant species is closely linked to actions to protect and restore perennial grasslands. In addition to supporting vernal pools, perennial grasslands provide valuable habitat for many wildlife species and provide important transitional habitat and support area for adjacent habitat. The design of restoration actions for perennial grasslands must include consideration and modification to accommodate special status plants.

**STAGE 1 EXPECTATIONS:** Distribution surveys will have been conducted or completed to identify special status plant habitats. This information will have been integrated into project planning for wetland and perennial grassland restoration actions.

The targets for these species include identifying and protecting high-quality habitats and populations and ensuring the long-term viability of the species on higher ranked sites.

- Acquire lands supporting existing populations or develop cooperative relationships with landowners to protect existing populations, beginning with the highest quality sites.
- Develop appropriate methods to protect and restore habitat and populations of special-status plant species.
- Manage protected areas occupied by the species to promote conditions favorable for the establishment, growth, and vigor of the species.
- Conduct a site-based evaluation of populations and rank sites based on criteria developed to assess habitat and populations conditions.

## MSCS CONSERVATION MEASURES

The following conservation measures were included in the Multi-Species Conservation Strategy (2000) to provide additional detail to ERP actions that would help achieve recurved larkspur habitat or population targets.

- To the extent consistent with ERP objectives, enhance or restore suitable habitats to benefit these species in occupied habitat areas.
- Develop a seedbank from all populations affected by implementation by CALFED actions and use the collected seed for inoculating unoccupied suitable habitat.

## REFERENCES

- Multi-Species Conservation Strategy. 2000. CALFED Bay-Delta Program Draft EIS/EIR Technical Appendix. July 2000.
- Natural Diversity Data Base. 1996. Record search for occurrence of *Fritillaria liliaceae* and *Delphinium recurvatum*. California Department of Fish and Game, Sacramento, CA.
- Strategic Plan for Ecosystem Restoration. 2000. CALFED Bay-Delta Program Draft EIS/EIR Technical Appendix. July 2000.

# ◆ SPECIES ASSEMBLAGES AND COMMUNITIES DESIGNATED FOR ENHANCE AND CONSERVE

## INTRODUCTION

The Strategic Plan for Ecosystem Restoration presents 6 goals to guide the implementation of restoration actions during the 20-30 year program.

The first Strategic Goal focuses on at-risk species:

*STRATEGIC GOAL 1: Achieve, first, recovery and then large self-sustaining populations of at-risk native species dependent on the Delta and Suisun Bay; support similar recovery of at-risk native species in the Bay-Delta estuary and its watershed; and minimize the need for future endangered species listings by reversing downward population trends of native species that are not listed.*

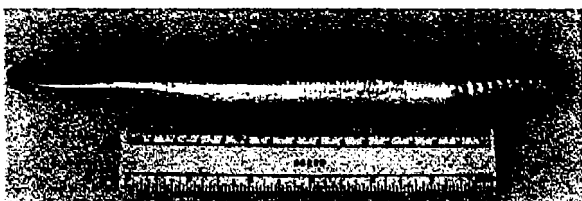
This section addresses those species designated as "Enhance and/or conserve" in the ERP.

**ENHANCE AND/OR CONSERVE "E":** For those biotic assemblages and communities (aquatic, terrestrial, and plant) designated "E", the CALFED Program will undertake actions to maintain and enhance their diversity, distribution and abundance in the Bay-Delta estuary and watershed as appropriate to reverse their declines or to keep abundances and distributions at their present levels.

The "enhance and/or conserve" species addressed in this section include:

- lamprey family
- native resident fishes
- native anuran amphibians
- migratory waterfowl
- shorebird guild
- wading bird guild
- neotropical migratory birds
- Bay-Delta foodweb organisms
- aquatic habitat plant community
- tidal brackish and freshwater habitat plant community, and
- seasonal wetland habitat plant community.

## ◆ LAMPREY FAMILY



### INTRODUCTION

Like any native species the lamprey is an indicator of ecosystem health. Although the lamprey does not hold any commercial or recreational value in California, its life history is similar to that of other anadromous species (salmonids). Loss of suitable spawning habitat and disturbance by humans has impacted the population of native lampreys. Even though these fish are predaceous in nature, they appear to have little affect on other resident fish species. Some California Native American tribes and European countries consider the lamprey a delicacy.

Factors that will limit the lamprey's ability to contribute to a healthy ecosystem are Delta outflow and spawning habitat in the upper rivers.

Little recent information regarding the abundance and distribution of lampreys in the Central Valley is available. This lack of information needs to be remedied by research into the basic biology of the genus, including life history studies, and data collection regarding abundance and distribution.

### RESOURCE DESCRIPTION

The lamprey is the most primitive of all fish species that reside in California waters. Of the four species of lamprey that can be found in California only three have life stages in the Sacramento-San Joaquin system. These are the river lamprey (*Lampetra ayresi*), Pacific lamprey (*Lampetra tridentata*) and the Pacific brook lamprey (*Lampetra pacifica*). Access to spawning grounds has been blocked by dams on both the Sacramento and San Joaquin rivers and their tributaries.

The river lamprey is an anadromous fish that is predaceous on fish in both salt- and fresh-waters. Adults migrate from the ocean and move into smaller tributary streams in April and May to spawn and die

shortly afterwards. Juveniles, called ammocoetes, remain in this life stage until they reach about 117 mm standard length (SL) and transform into adults and emigrate to the ocean.

The Pacific lamprey is an anadromous fish that spends its predatory phase in the ocean. Migration occurs between April to late-July with adults moving upstream several month prior to spawning. After spawning, the adults die and the eggs settle and adhere to the substrate. Between 140 mm and 160 mm the ammocoetes begin the transformation into adults and migrate to the ocean.

The Pacific brook lamprey is a relatively small, (when compared to other lampreys) non-predaceous fish that resides in the lower reaches of the Sacramento-San Joaquin rivers. Spawning is believed to occur from July through September in the upper reaches of the San Joaquin River.

The health of lamprey populations is adversely affected by the following general types of activities or conditions:

- urbanization
- agricultural practices
- livestock grazing and dairy farming
- timber harvesting
- gravel mining
- water development
- summer dams
- urban runoff
- wastewater discharge, and
- flood control and bank protection.



### VISION

The vision for anadromous lampreys is to maintain and restore population distribution and abundance to higher levels than at present.

The vision is also to understand life history better and identify factors which influence abundance. Better knowledge of these species and restoration would ensure their long-term population sustainability. A major focus of the efforts would be to improve access to historic spawning grounds within California. Many

of the efforts described in the Stage 1 Actions that would benefit anadromous fish species would directly effect all lamprey populations due to their similarities in spawning habitat and flow requirements.

On the Sacramento side of the system efforts to expand access to spawning habitats would need to be accomplished. On the San Joaquin side of the system, efforts would need to be directed towards improving the overall health of the river (water quality) in addition to improving access to historic spawning grounds.

## INTEGRATION WITH OTHER RESTORATION PROGRAMS

Other programs linked to restoring habitat used by anadromous lamprey include all the programs directed at the restoration of habitat for chinook salmon and steelhead. Although lamprey are not directly targeted by these restoration programs, lamprey will derive benefits directly from programs that address habitat. Lamprey habitat will also improve with the implementation of improved watershed management program. The CALFED Watershed Management Coordination component is not an element of the ERPP.

- Central Valley Project Improvement Act: The Secretary of the Interior is required by the Central Valley Project Improvement Act to double the natural production of Central Valley anadromous fish stocks by 2002 (USFWS 1995) by implementing a variety of measures including habitat restoration.
- Salmon, Steelhead Trout and Anadromous Fisheries Program Act: The California Department of Fish and Game (DFG) is required under State legislation (the Salmon, Steelhead Trout and Anadromous Fisheries Program Act of 1988) to double the numbers of salmon that were present in the Central Valley in 1988 (Reynolds et al. 1993). Implementation of this program will increase the suitability of aquatic habitats required by lamprey.
- CALFED Watershed Management Coordination Program: The watershed program is designed to reduce stressors resulting from mining practices, agricultural discharges, excessive runoff and erosion, wildfire, excessive timber harvest,

livestock grazing, and damaging land use practices that constrain ecological health of the streams.

## LINKAGE WITH OTHER ECOSYSTEM ELEMENTS

Restoration of the lamprey populations and their habitats will be integrally linked to:

- maintaining essential fish habitats,
- restoration of natural stream meander corridors,
- providing suitable water temperatures for rearing,
- providing flows for migration, and
- reducing or eliminating the adverse effects of stressors such as contaminants, gravel mining, unscreened diversions, and other sources of mortality.

## OBJECTIVE, TARGETS, AND ACTIONS



The Strategic Objective is to enhance and/or conserve native biotic communities in the Bay-Delta estuary and its watershed.

**SPECIES TARGET:** Evaluate the status and life history requirements of Pacific lamprey and river lamprey in the Central Valley and determine their use of the Delta and Suisun Bay for migration, breeding, and rearing.

**LONG-TERM OBJECTIVE:** Restore wild self-sustaining populations of anadromous lampreys to all accessible rivers in which they historically occurred.

**SHORT-TERM OBJECTIVE:** Evaluate the status and life history requirements of Pacific lamprey and river lamprey in the Central Valley and determine their use of the Delta and Suisun Bay for migration, breeding, and rearing.

**RATIONALE:** Lampreys are anadromous species that clearly have declined in the Central Valley although the extent of the decline has not been documented. Pacific lamprey probably exist in much

of the accessible habitat available today but this is not known. The decline of lampreys is presumably due to the decline of salmonids (major prey species), to deterioration of their spawning and rearing habitat, to entrainment in diversions, and to other factors affecting fish health in the system. As for salmonids, much of the habitat previously available for wild-spawning lampreys is permanently disconnected from the migration corridors. However, the remaining habitat or, the "new" habitat in the tailwaters of large dams, should be useable for spawning. Presumably, restoration of salmonid populations will also benefit lampreys, although this assumption should be regarded as a hypothesis, not a fact. If the assumption is not true, lampreys may have to be treated as Priority Group I species.

**STAGE 1 EXPECTATIONS:** Surveys will have been conducted to determine the status of lampreys in the Central Valley and a status report should be in place that recommends restoration actions.

## RESTORATION ACTIONS

The target for lamprey populations would be to double and maintain the population of all lampreys within the Central Valley.

All lamprey populations would benefit from the following restoration activities and actions:

- restoration activities to spawning sites in the upper rivers and tributaries of the Central Valley,
- increased river flows,
- removal of barriers to historic spawning grounds,
- improved water quality in the San Joaquin River System,
- remove existing threats to known populations,
- restore habitat conditions favorable to the survival of lampreys and other native aquatic species, and
- protect and monitor lamprey populations and habitat once the threats have been removed and restoration has been completed.

## REFERENCES

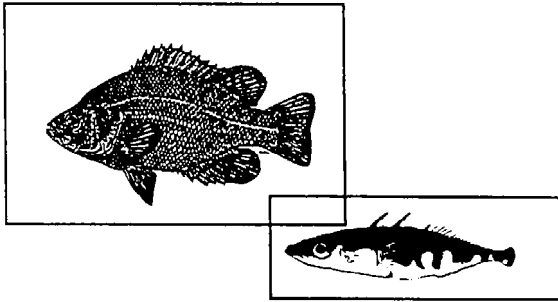
Moyle, P.B. 1976. *Inland Fishes of California*. University of California Press, Berkeley. 405 pp.

Scott, W.B. and E.J. Crossman. 1973. *Freshwater fishes of Canada*. Fisheries Research Board of Canada. Bulletin 184. Ottawa, Canada. 966 pp.

Strategic Plan for Ecosystem Restoration. 2000. CALFED Bay-Delta Program, Programmatic EIS/EIR Technical Appendix. July 2000.

Wang, Johnson, C.S. 1986. *Fishes of the Sacramento-San Joaquin Estuary and Adjacent Waters, California: A Guide to the Early Life Histories*. IESP Technical Report 9. pp 1-1.

## ◆ NATIVE RESIDENT FISH SPECIES



### INTRODUCTION

Native resident fish species of the Delta are important ecologically and as indicators of ecosystem health. Some, such as the tule perch, Sacramento sucker, and threespine stickleback, are important elements of the Bay-Delta foodweb. Other, such as the Sacramento pikeminnow (Sacramento squawfish), are important predators. Native resident fishes have declined as a percent of the total fish species abundance of the Bay-Delta and its watershed.

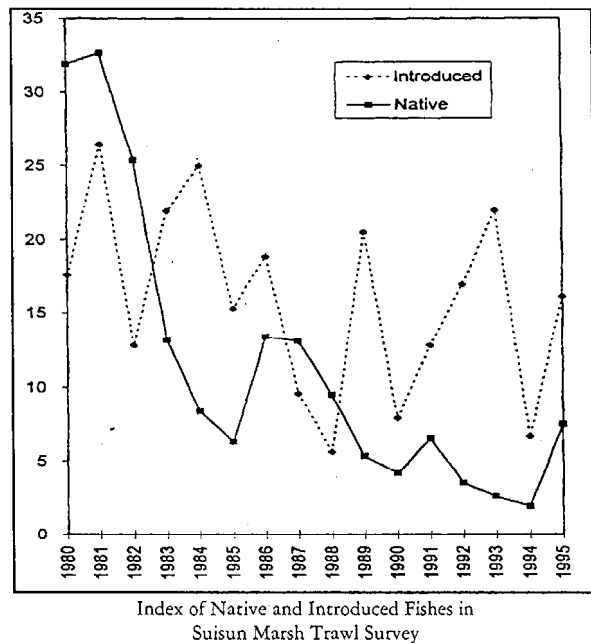
Factors contributing to the decline of some important native resident species include predation and competition of non-native species, loss and degradation of habitat, poor foodweb productivity, losses to water diversions, and reduced survival from exposure to toxins in the water.

### RESOURCE DESCRIPTION

Native resident species compose the bulk of species found in fresh and low-salinity water (i.e., less than 4 parts per thousand salinity) of the Sacramento-San Joaquin Delta estuary. Resident species represent an important component of sport catch and the historical native fish fauna (e.g., tule perch, Sacramento blackfish). In addition, other native minnows such as hardhead, hitch, and California roach are important species occupying important and diverse ecological niches in Central Valley low to mid-elevation streams.

As with other Delta species, the habitat of resident fishes has been greatly diminished by human-caused actions. Increased habitat and expanded distribution and abundance of resident species can be realized through restoring habitat together with improving natural ecological processes and functions.

Spawning and rearing habitat includes shallow edgewaters bordered by healthy riparian and aquatic plants that provide protective, food-rich environments. Productive edgewater habitats are currently very limited in the Delta. Many resident Delta species inhabit shallow areas that have structural diversity provided by riparian and aquatic vegetation. Levee construction in the 1800s created narrow channels and eliminated vast areas of tule marsh, areas most likely important as spawning and rearing habitat for Delta species. Levee maintenance programs that remove riparian vegetation and dredging continue to reduce the quality of shallow water habitat used by resident species. Erosion caused by increased flow velocity, changes in channel structure, and boat wakes continues to reduce remnant riparian, marsh, and channel island habitats. Water hyacinth and other exotic aquatic plants now clog many sloughs that are important habitat of resident fish.



Losses to Delta diversions (e.g., hundreds of small agricultural diversions, Central Valley Project and State Water Project export pumps, and Pacific Gas & Electric power generation facilities) may reduce resident species abundance through direct entrainment or indirect effects on the prey of resident fish.